

FY2016

R&D Strategy  
Briefing

October 20, 2016

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# Fujitsu Laboratories' R&D Strategies

CEO  
FUJITSU LABORATORIES LTD.

Shigeru Sasaki



- Fujitsu Laboratories' Role
- Digital Transformation
- R&D for realizing Hyperconnected Cloud
- Main Topic for Today's Press Release
- Technology Exhibits

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# Fujitsu Laboratories' Role



# Fujitsu Laboratories: Mission

Driving the Fujitsu Group growth  
with leading-edge technologies



# Positioning of Fujitsu Laboratories

Through Co-Creation,  
create values, develop new markets,  
and contribute to the core businesses

**Business**

**Fujitsu Limited and  
Subsidiaries**

R&D

Strategy  
Taskforce

R&D  
Investment

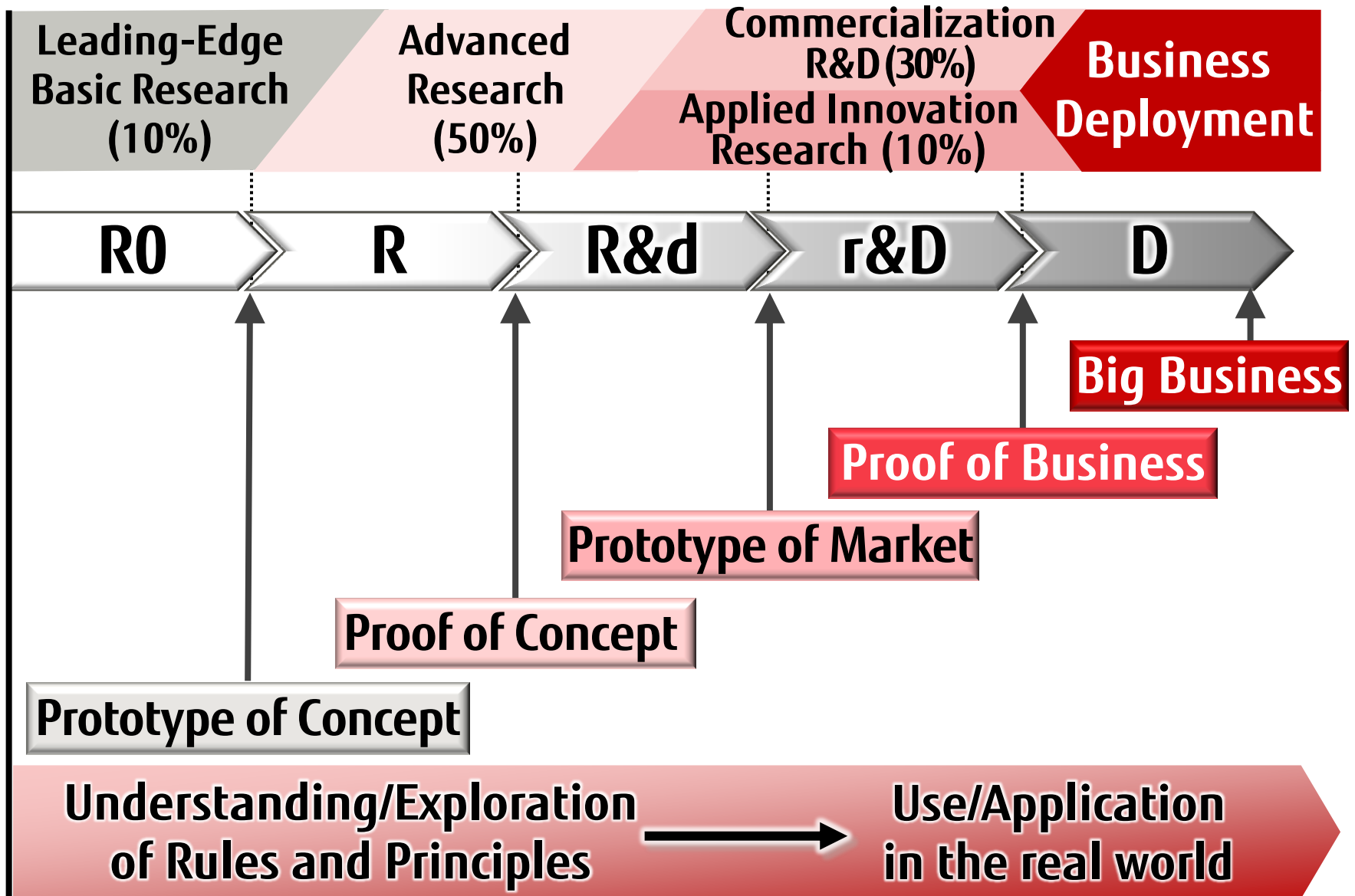
Government  
Projects

Universities  
& Research  
Institutes

**Fujitsu Laboratories**

**Technologies and market trends  
Customer and partner needs**

# Flow of R&D and Business Deployment





# Outline of R&D Activities

- R&D Budget: Approx. 30 Billion JPY, Approx. 300 Million USD
- Employees: Approx. 1200 in Japan, Approx. 65 in U.S., Approx. 120 in China, Approx. 45 in Europe
- Open Innovation: 84 Projects in Japan, 11 Countries, 58 Projects in overseas

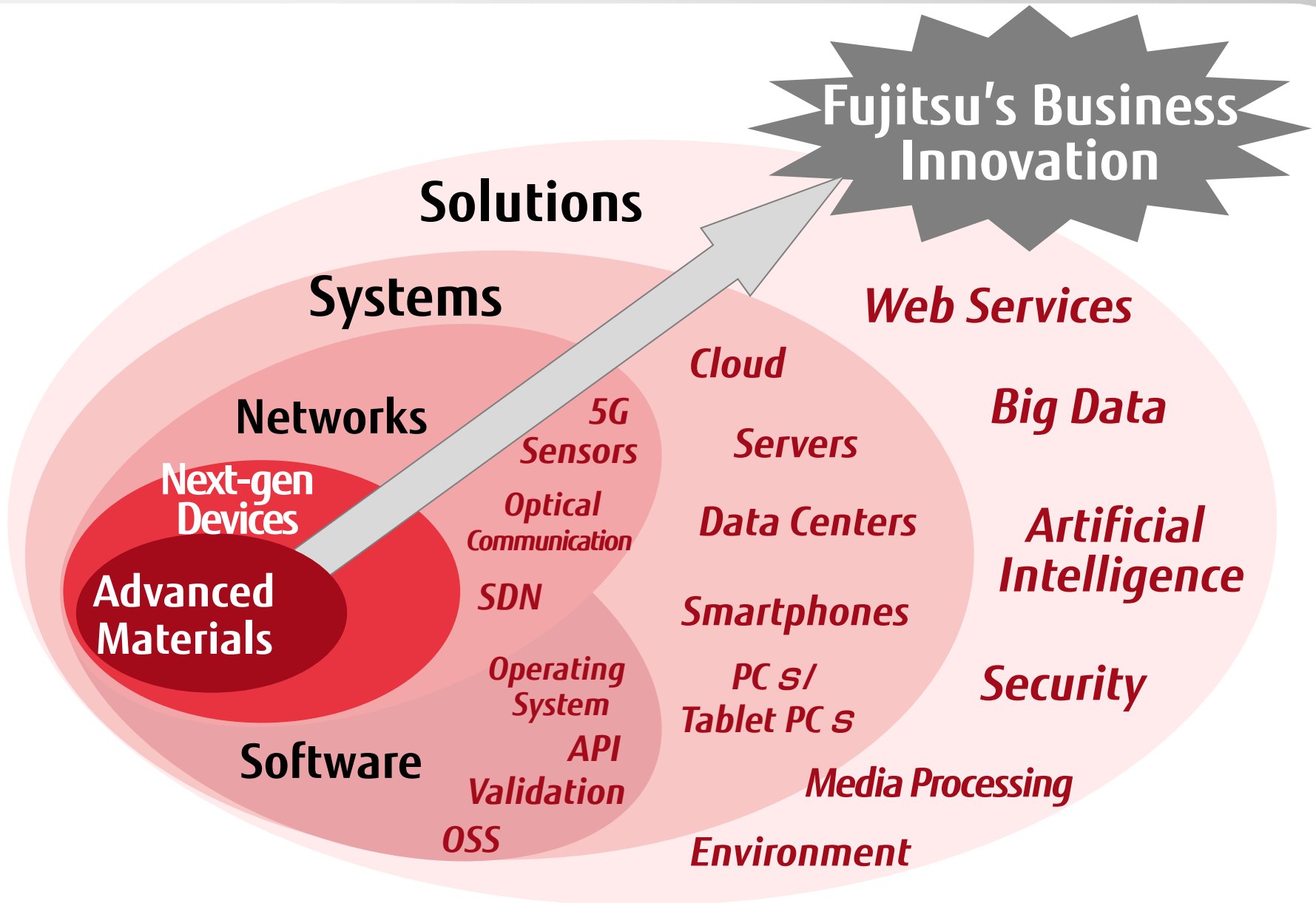


**Continuously generating R&D results that will amaze the world**

**Quickly deploy R&D results to Proof of Concept and Proof of Business on a global scale**

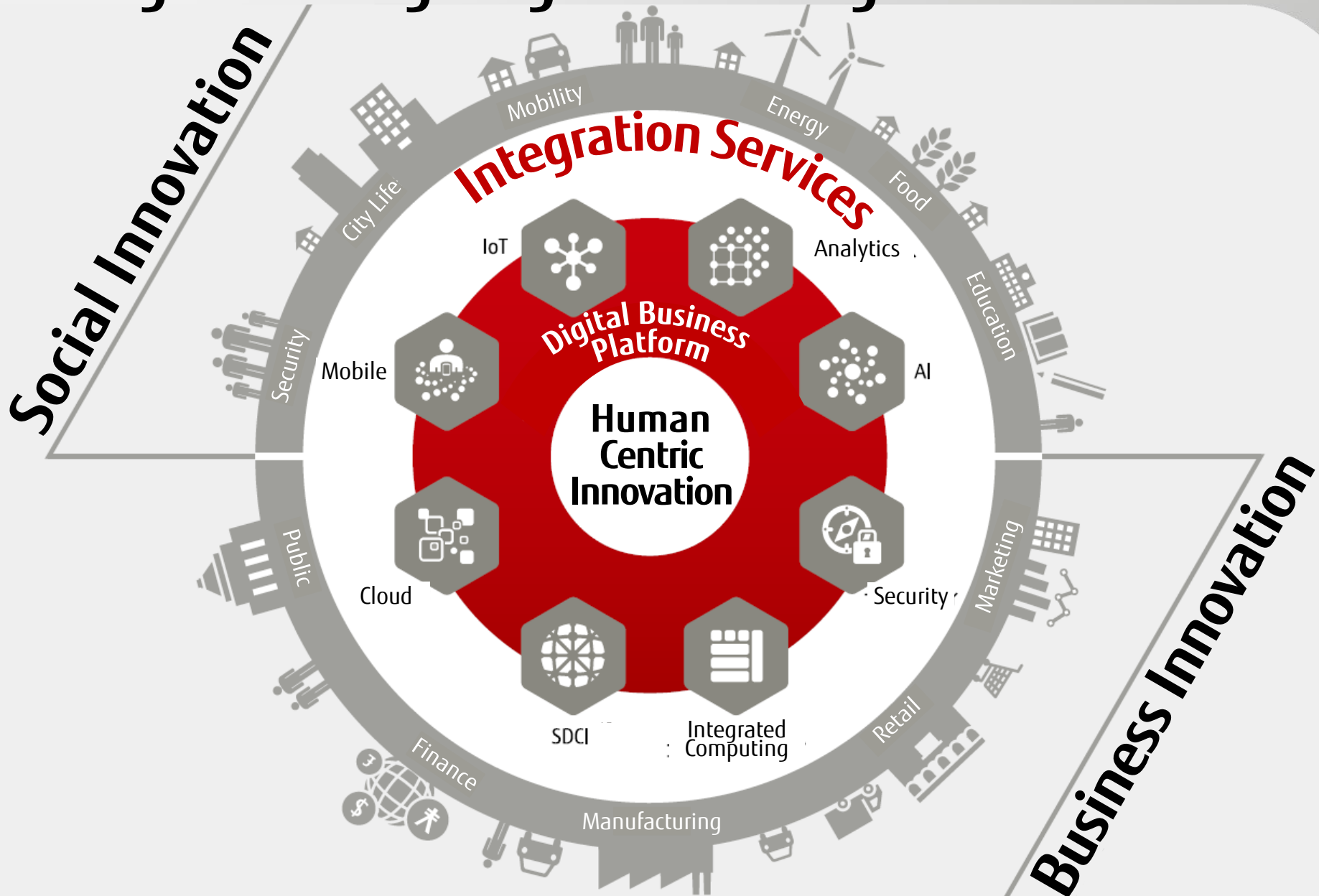
**Generating innovations, including new business models that resonate through global markets**

# Technology Value Chain of R&D Themes





# Providing Useful Values to Fujitsu Customers through Leading-Edge Technologies



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# Digital Transformation



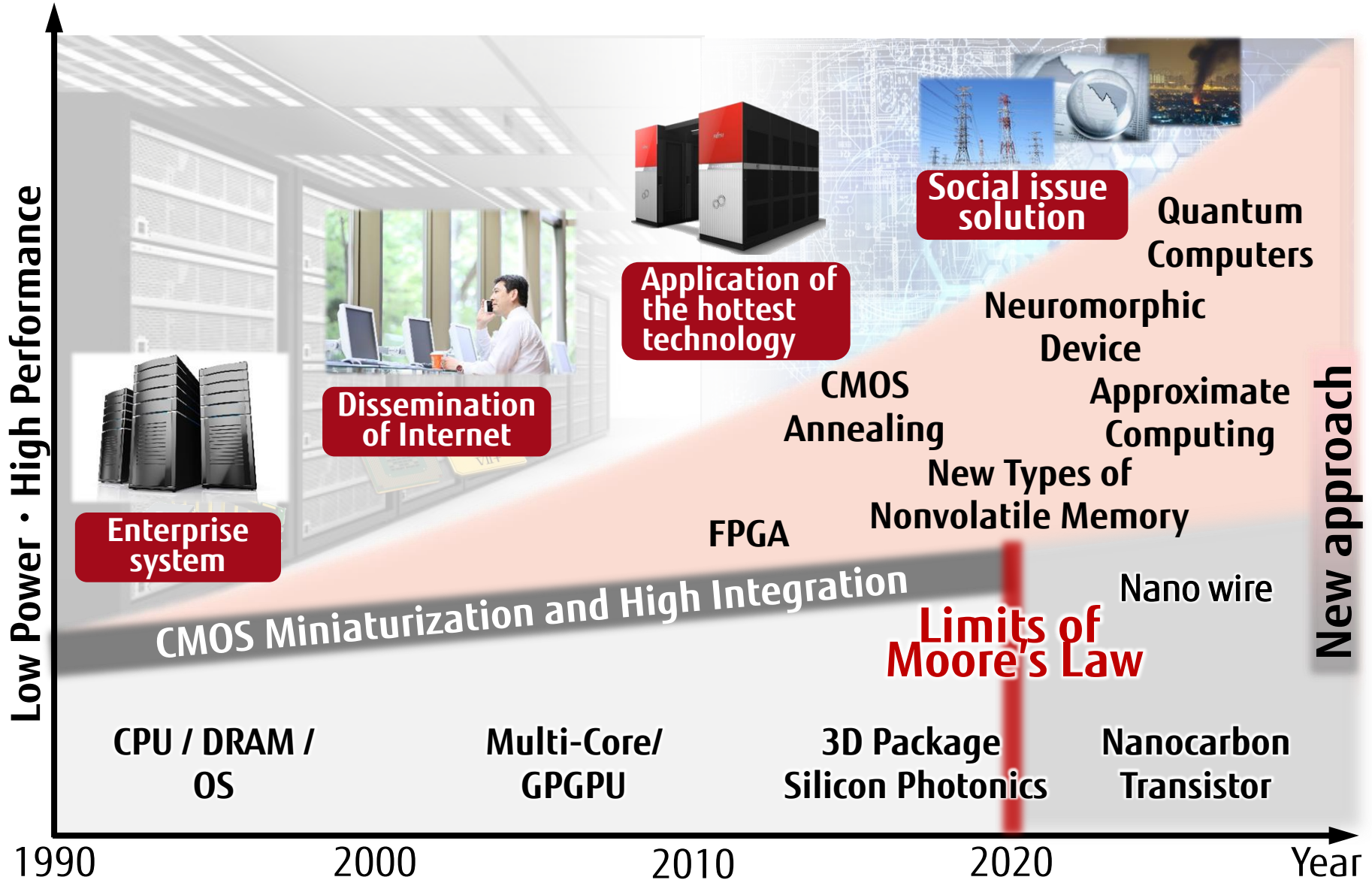
# Digital Transformation

■ Number of connections IPv6 : 340 undecillion

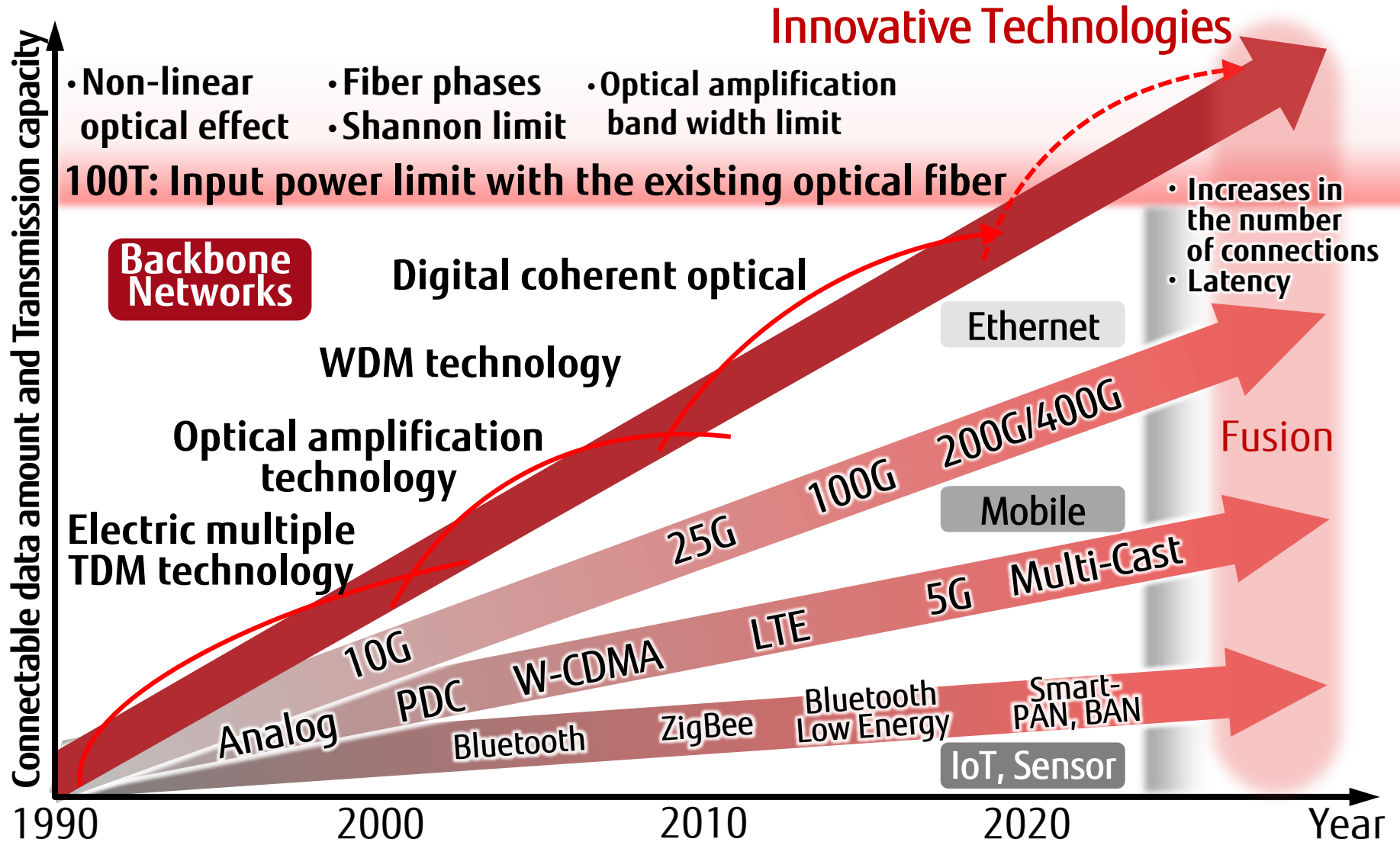
⇒ World population: Approx. 7.5 billion Approx. 45 octillion NW connections



# Trends in the Improvement of Computing Performance

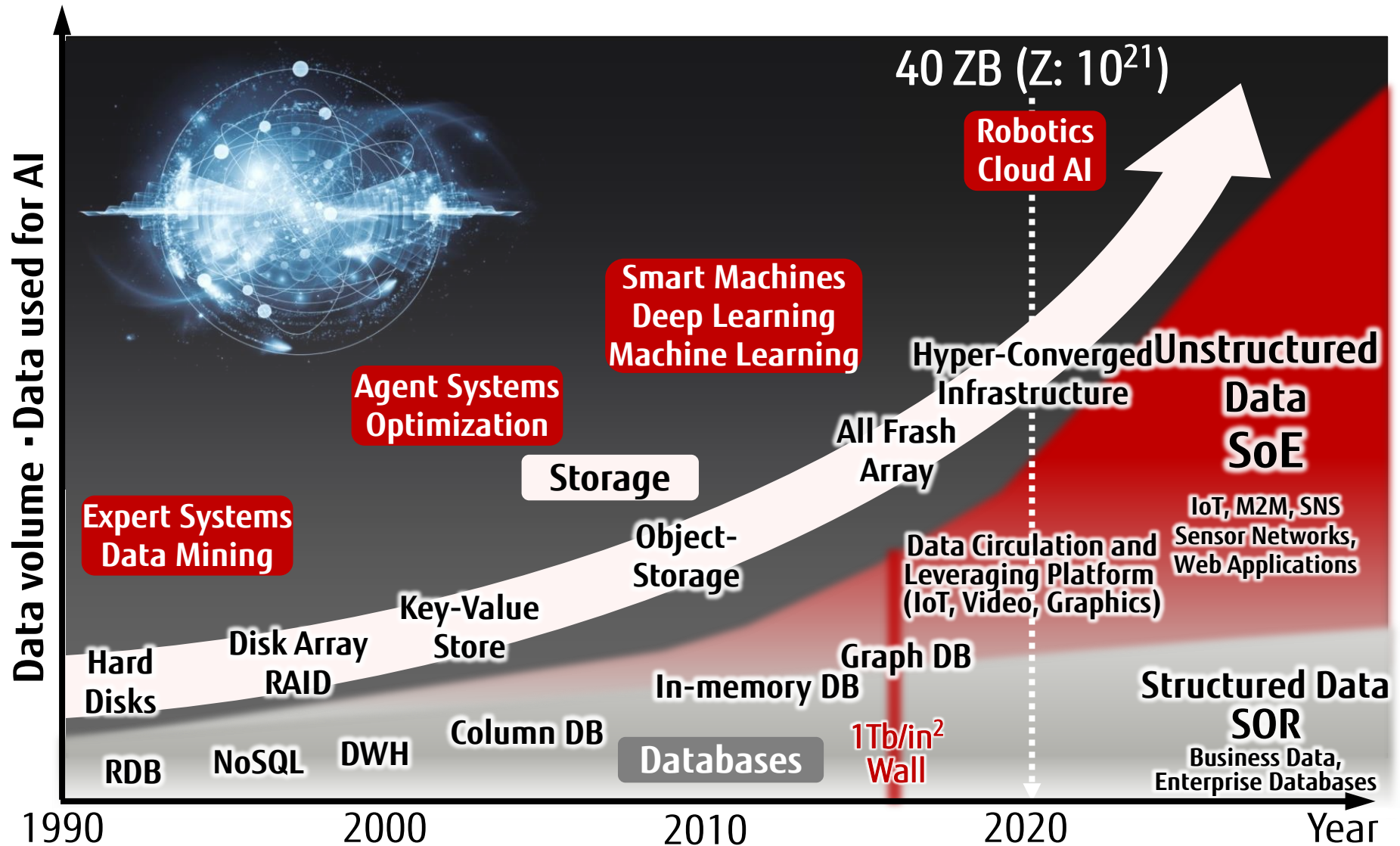


# Trends in Connection Technology

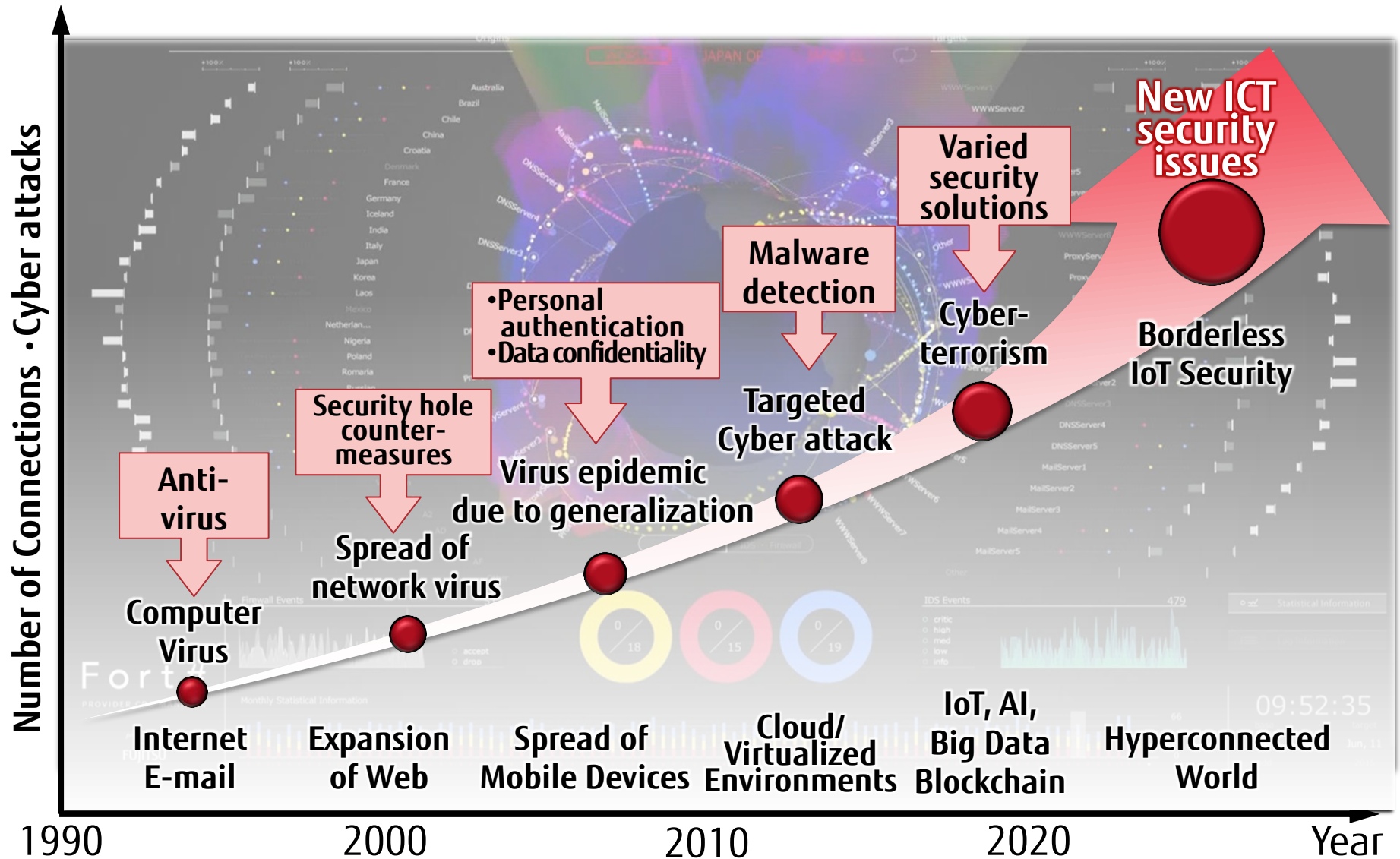




# Trends in Data Volumes and Conversion into Knowledge



# Importance of Security Technology Accompanying the Advance of ICT



# Co-Creation by Digital Business Platform

New Services, New Businesses, New Ecosystems  
**"Digital Business Platform"**

**Co-creation**  
Cross-industrial sector / Different field cooperation

Applications  
Data  
**A Company**

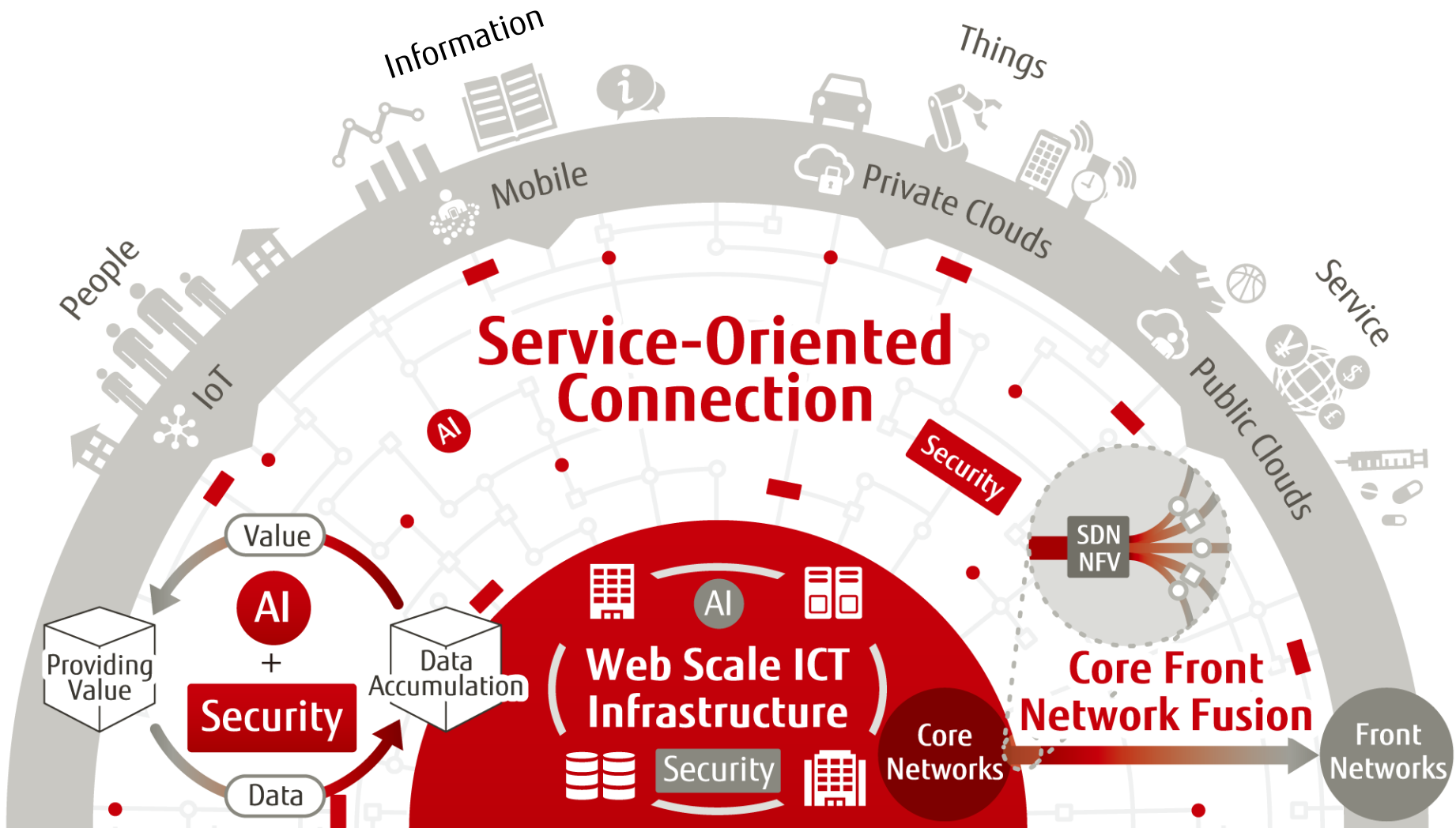
Data  
Services  
Applications  
**B Company**

Applications  
Public Data  
Open Data  
**Public Sector  
Public Domain**

Knowledge  
Technology  
**Fujitsu**



## Hyperconnected Cloud



# R&D for Realizing Hyperconnected Cloud

- 5 R&D Domains
- Applied Research
- Leading-Edge Basic Research

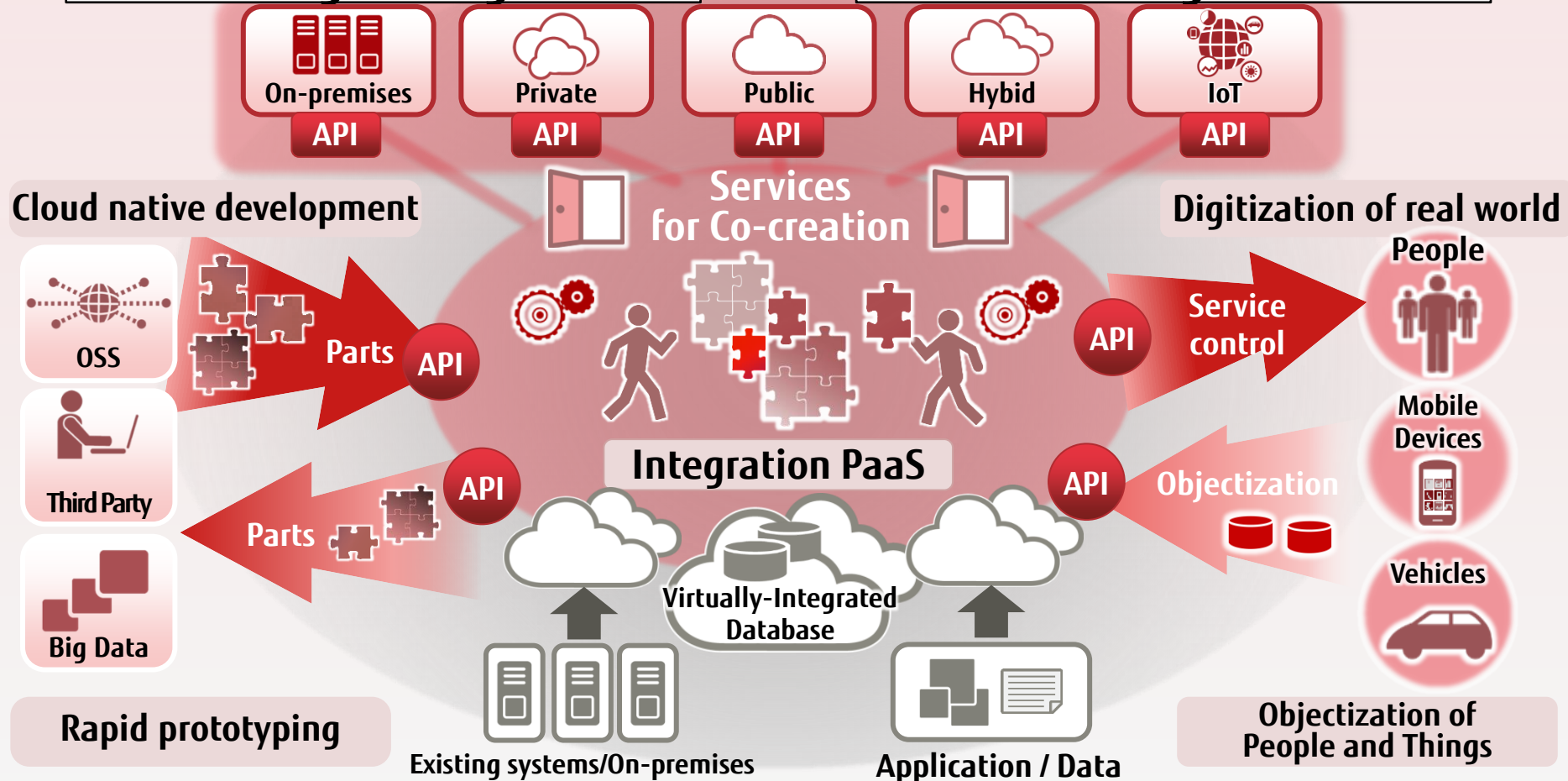


# Service-Oriented Connection

- Integrate the Front (field area) networks as real world objects and Clouds, and develop a co-creation platform that seamlessly connects all of these networks.
- Provide the necessary services easily at a high speed by using data applications that are available from virtually integrated database of integration PaaS.

## Knowledge Integration

## IoT Integration





# Web Scale ICT Infrastructure

- ICT infrastructure that is continuously evolving while dynamically allocating the required functionalities and resources
- Next generation computing architecture surpassing the limit of existing calculation capability

## Next-gen Computing

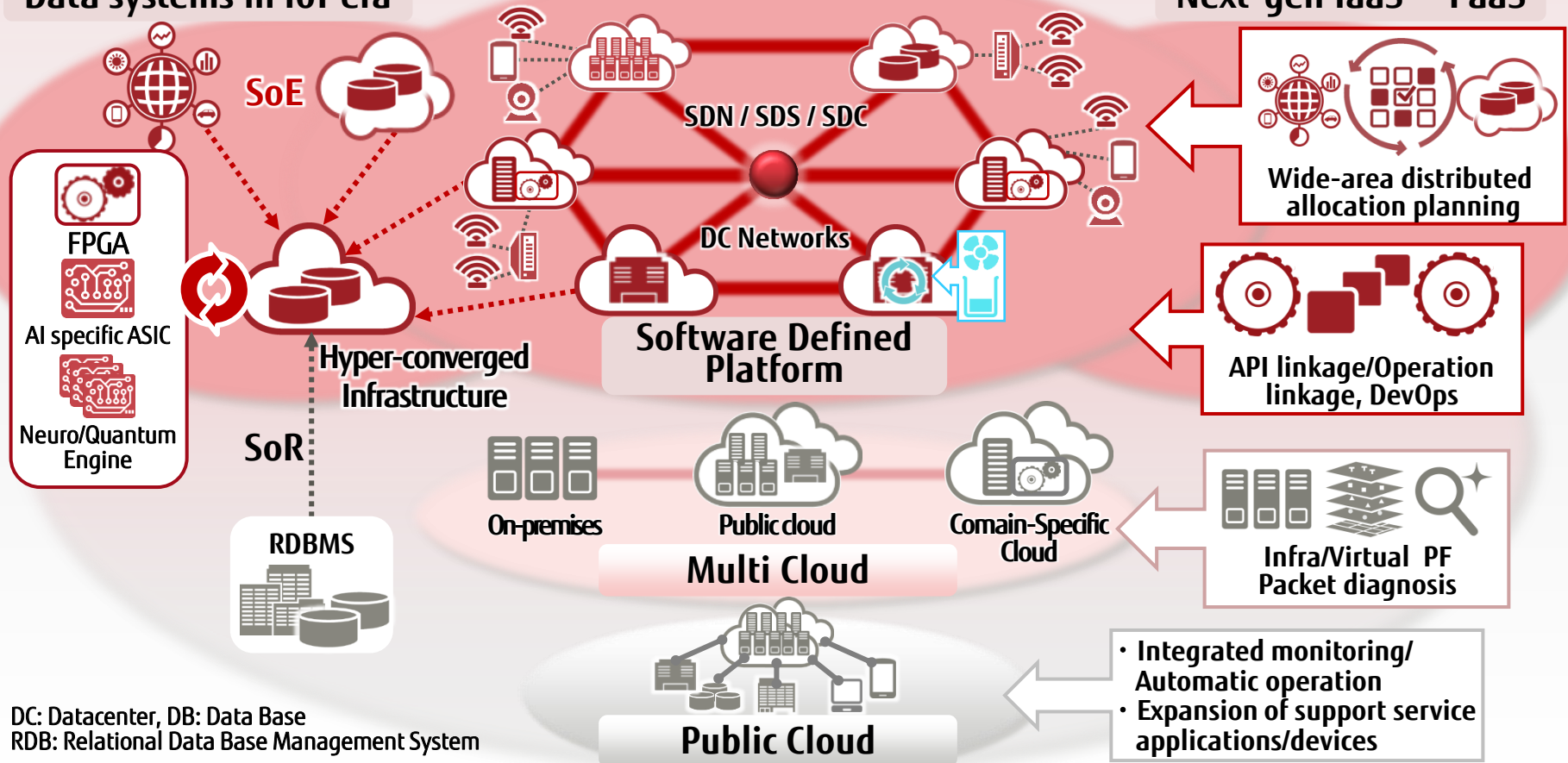
Data systems in IoT era

## New-Generation Cloud Platform

### Hyper-Scale Cloud

## Cloud Management

Next-gen IaaS · PaaS



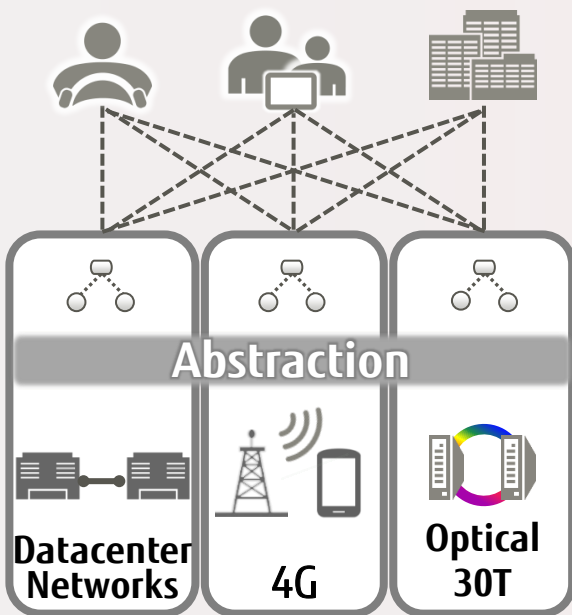
DC: Datacenter, DB: Data Base  
RDB: Relational Data Base Management System

# Core / Front Network Fusion

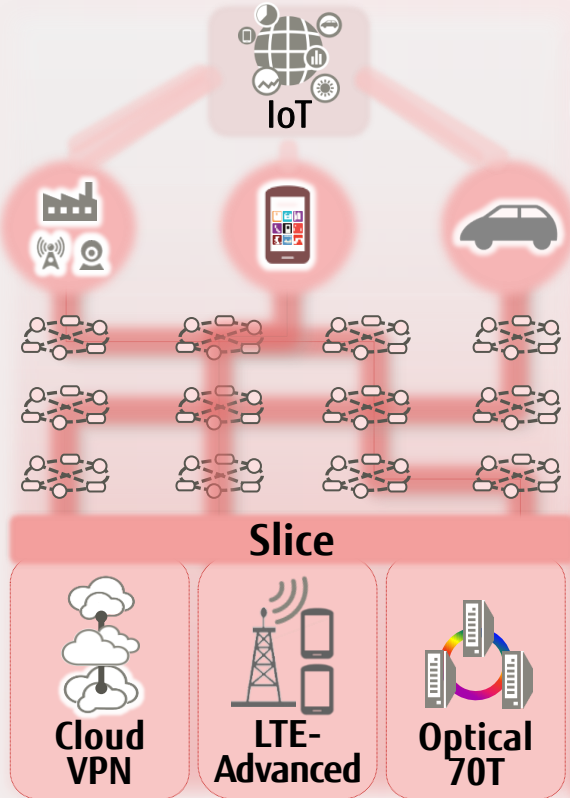
- Virtual network that connects various things on the network from end to end optimally at a high speed regardless of physical network types.
- Create the required services by One Network that seamlessly connects from Core to Front networks.

## Networks Virtualization

### "Closed" Virtual Networks



### Virtual Networks "Quickly Connecting from End to End"

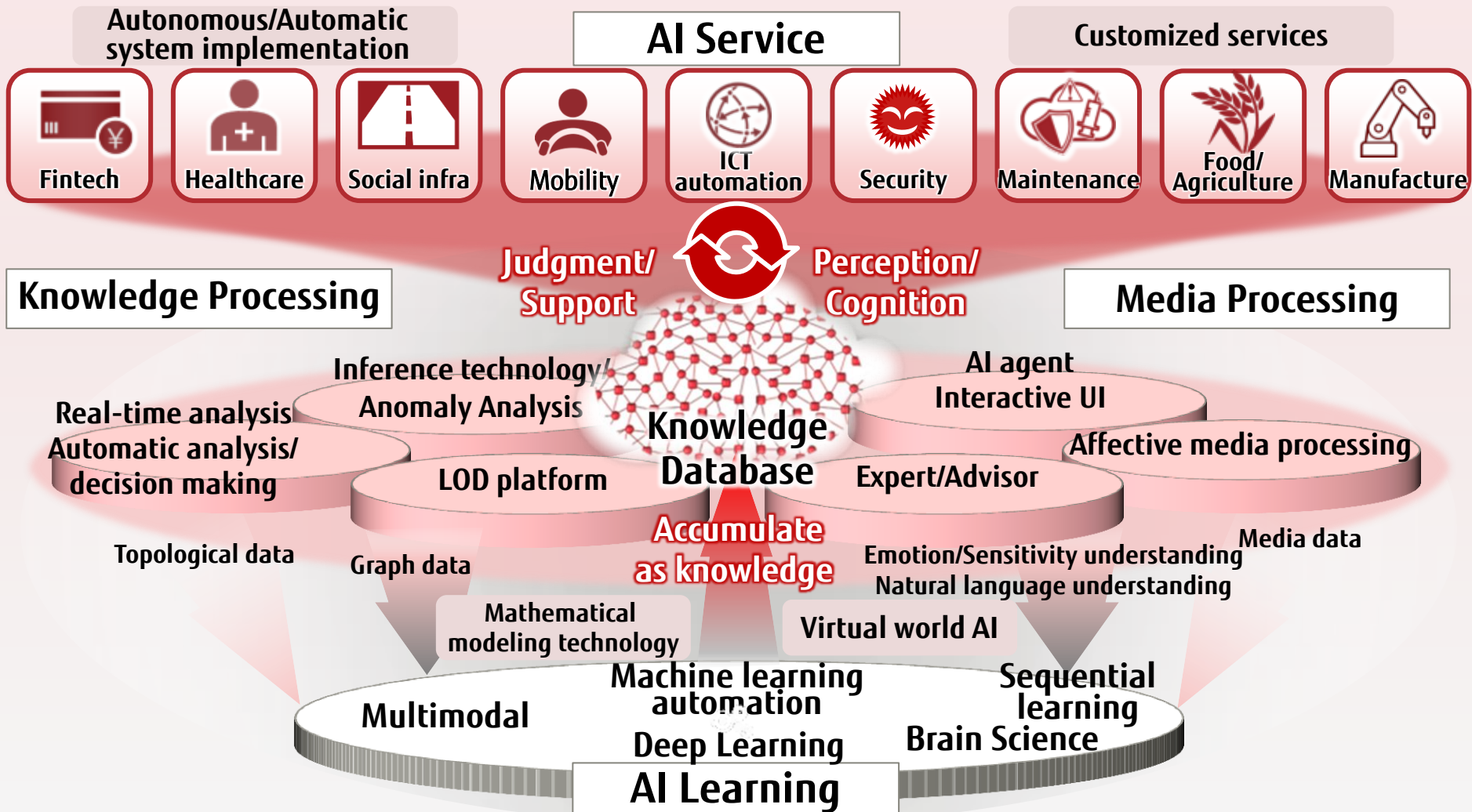


### NW to connect and integrate service parts



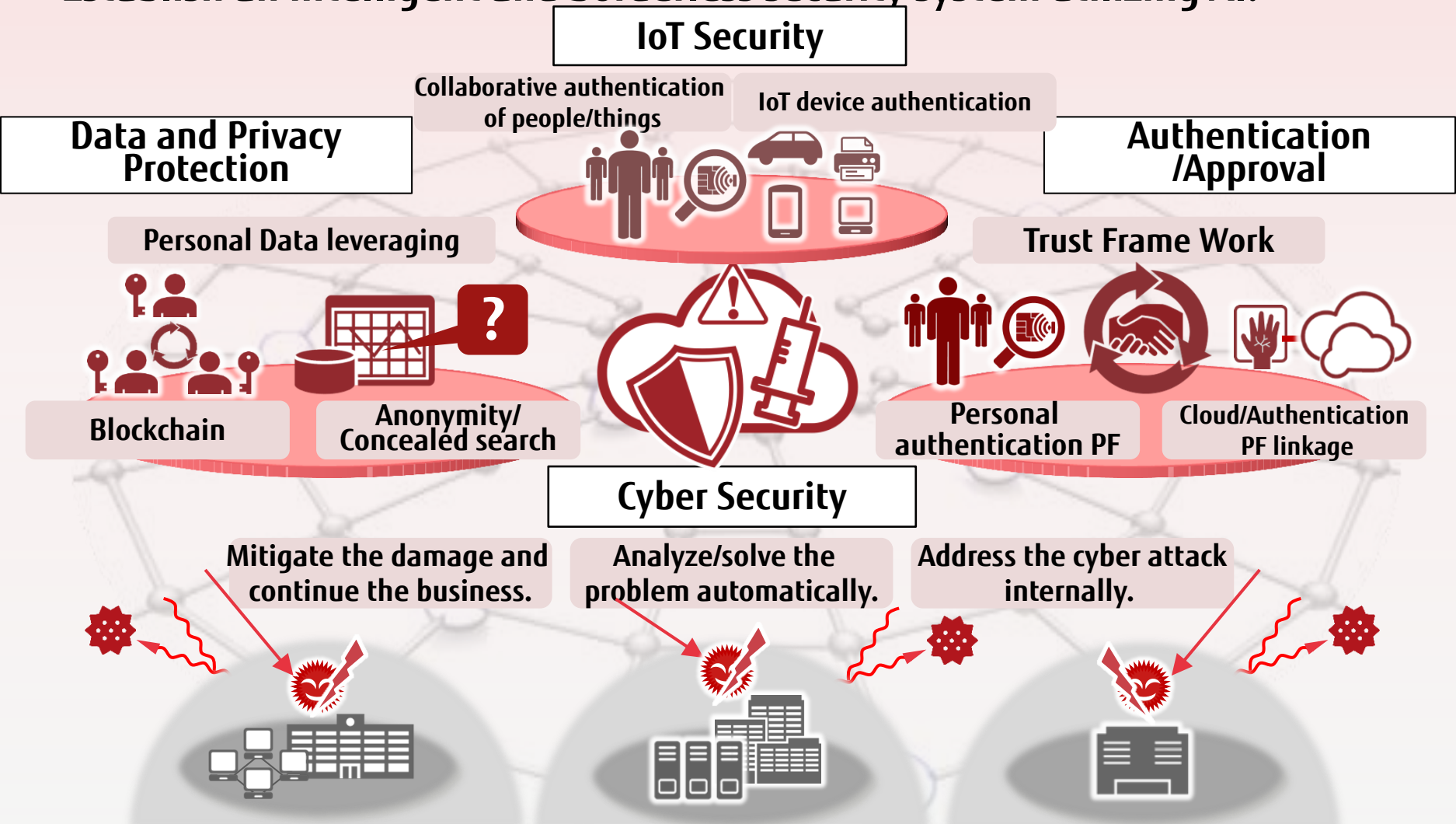
## Physical Networks

- Develop a technology that creates new knowledge based on the knowledge obtained from experience and deploy this technology to various fields in the society
- Human-Centric AI that can understand the human 5-sense and affections by media processing technology



# Security

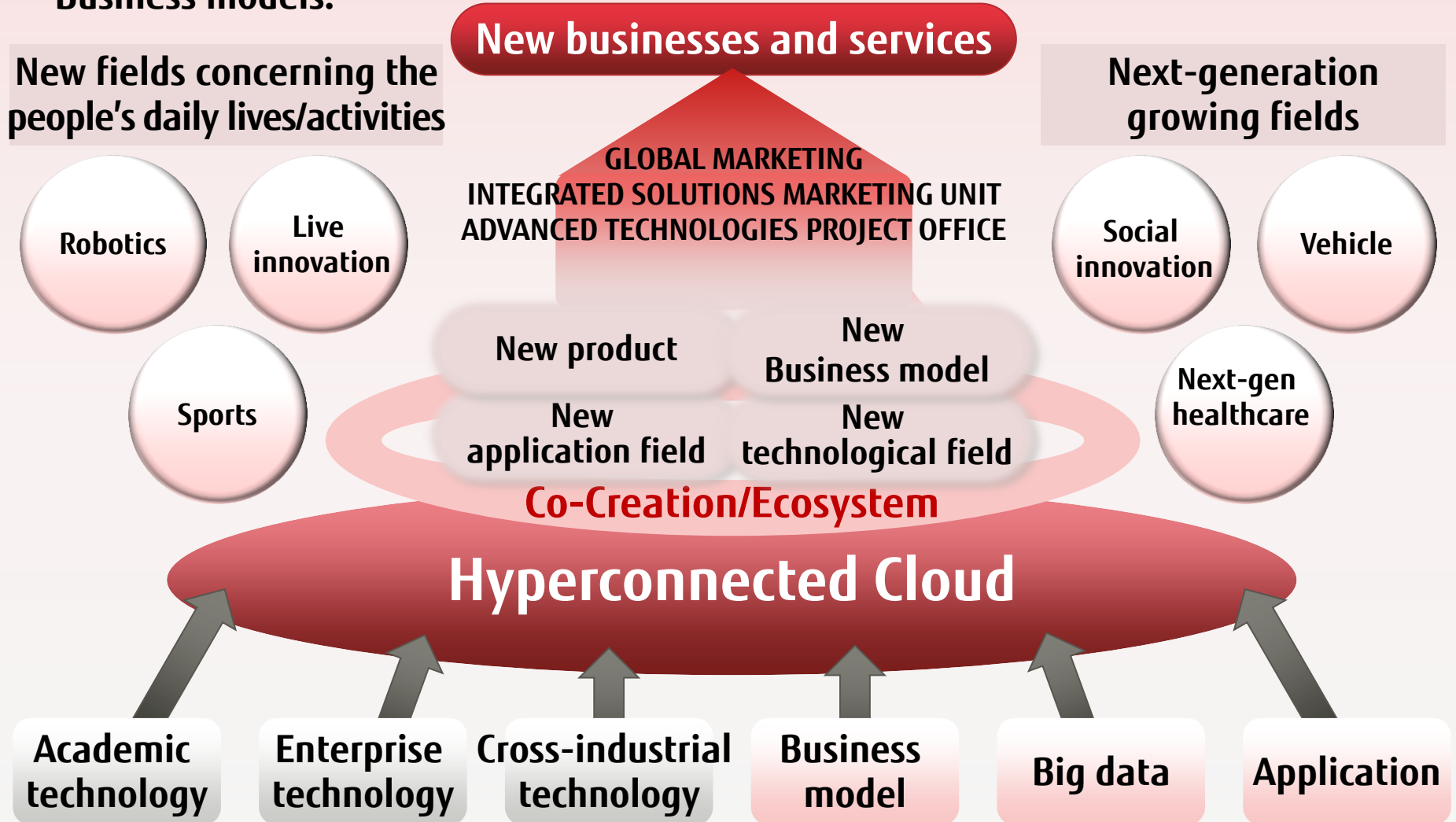
- Solving new security issues which are arising along with ICT progress, realize a safe and secure society.
- Establish an intelligent and borderless security system utilizing AI.





# Applied Innovation Research

- Co-create new ICT businesses and services and use them actually in our daily lives through Hyperconnected Cloud that provides various "Technologies and Business models."



## ■ Challenging the limitations of ICT

### ■ **Computer Architecture**

Intelligent computing supporting people with autonomous learning (Domain-Specific, Quantum, Neuro, Brain-Type)

### ■ **Network Architecture**

Challenging the limitations of optical/radio communications and enhancement of software-defined communication technology

### ■ **7-Sense Computing**

Autonomous actions based on understanding of human affections, emotion, five senses, sixth sense (intuition), and illusion

### ■ **Social Science**

Analysis/evaluation/verification of social phenomenon and economic change through empirical approach

### ■ **Physical and Chemical**

New device/3D packaging/Energy creation technologies, by materials informatics and biomimetics

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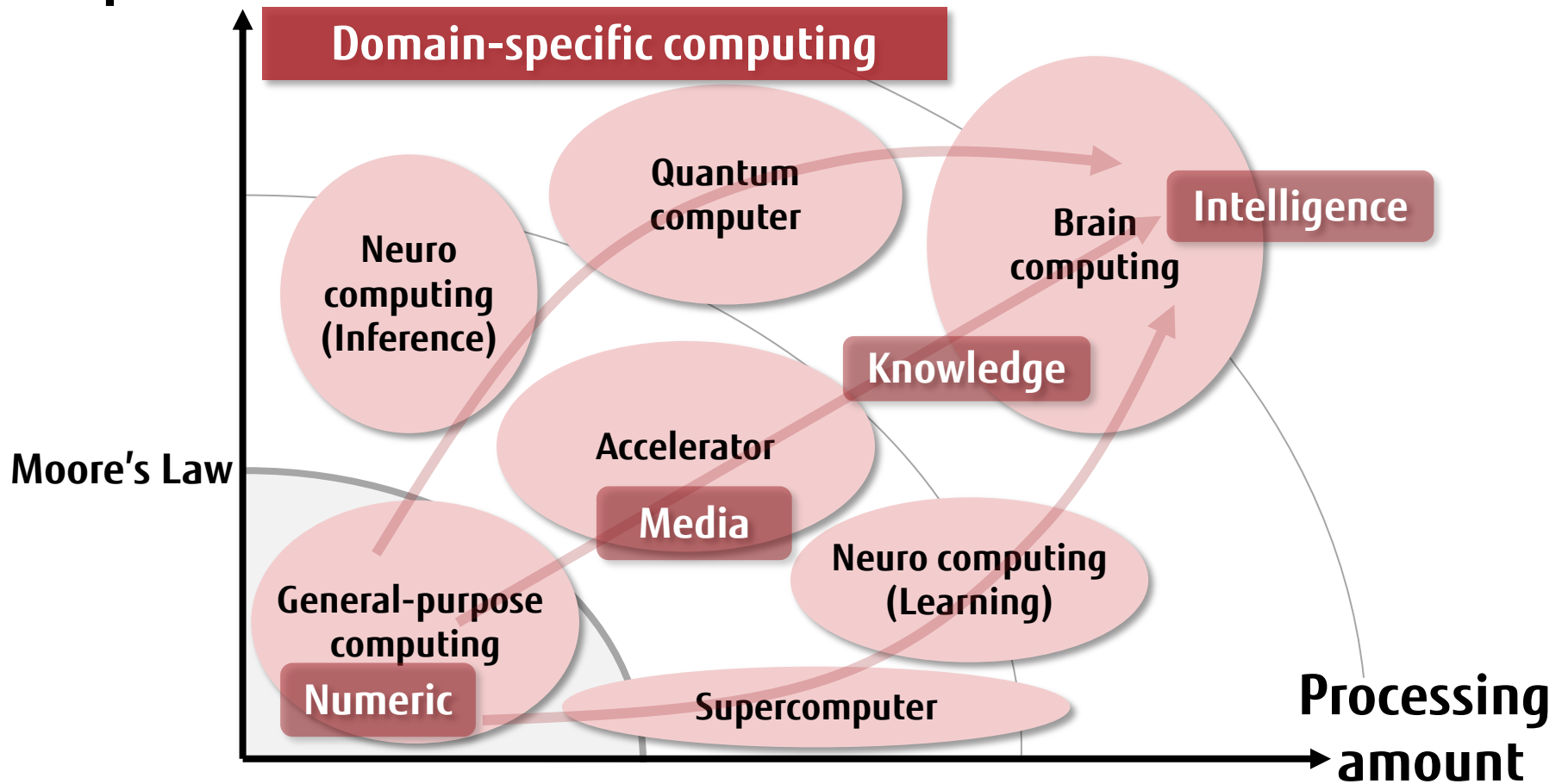
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# Main Topic for Today's Press Release

# Fujitsu Laboratories' Vision for Future Computing

## ■ Creating a new computer architecture toward the intelligent computing era

Specialization





# Human Brain and Artificial Intelligence



5-sense (Eyesight, Hearing, Smell, Taste, Touch)  
 Memory, Recognition, Knowledge, Experience, Illusion,  
 Forgetfulness, Consciousness,  
 Unconsciousness, Common Sense,  
 Learning

Sensor fusion  
 Storage, Computing,  
 Cause and effect understanding/explanation,  
 Frame problem,  
 Machine learning

Human: Number of neurons	
Cerebrum	14 billion
Cerebellum	Approx. : 100 bil.
Sense organs: Eye, Ear, Nose, Tongue, Skin	

ICT · AI	
Computer	up to PFLOPS
Storage	up to 10 Tbit/in <sup>2</sup>
Connectable count: $340 \times 10^{36}$	

# Fujitsu Laboratories' Concept of AI

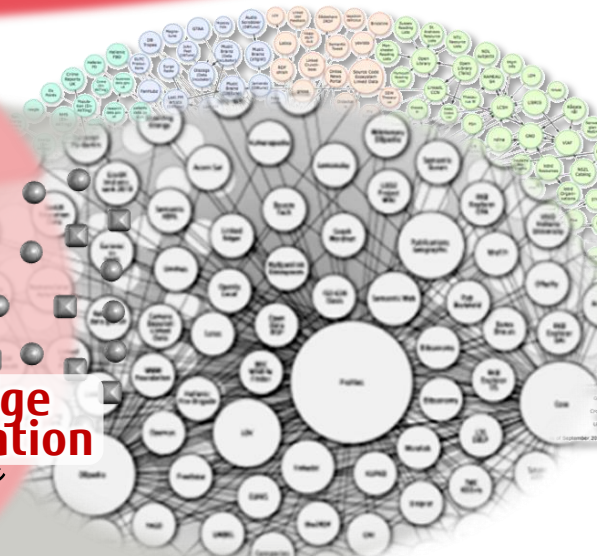
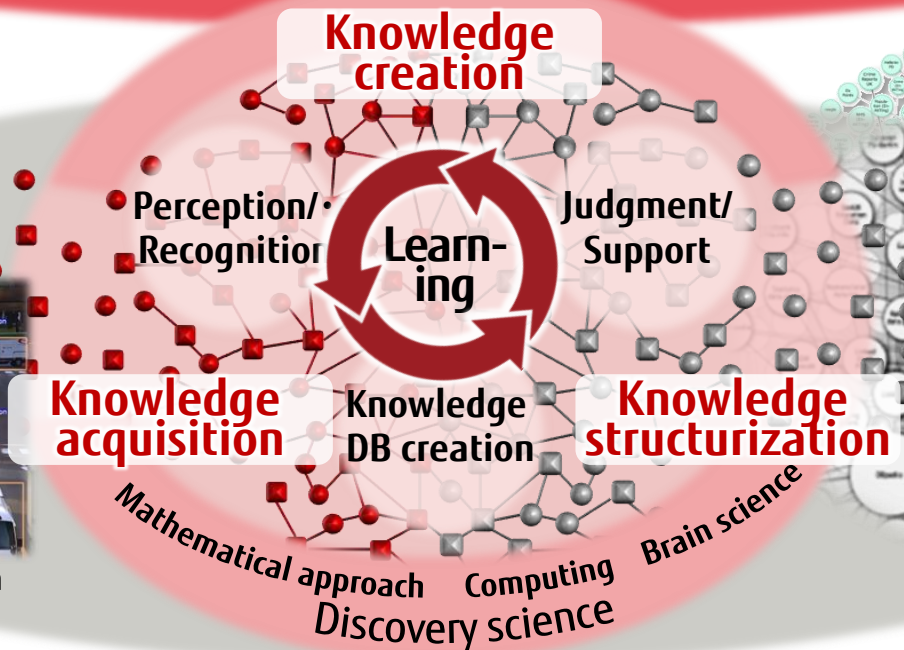
- **Structurization of existing knowledge:** Utilize the vast knowledge produced by human beings around the world.
- **Acquisition of unknown knowledge:** Utilize the vast knowledge accumulated by sensing devices in a real world.
- **Creation of Knowledge:** R&D for learning and discovery science



AI that is highly acceptable to society



Massive amounts of media data and five sense information that are collected by sensing devices in a real world



Vast knowledge scattered around the world which is produced by human beings



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# Technology Exhibits



# Technology Exhibits presented today (1/2)

## Service-Oriented Connection (2 out of 14) \*

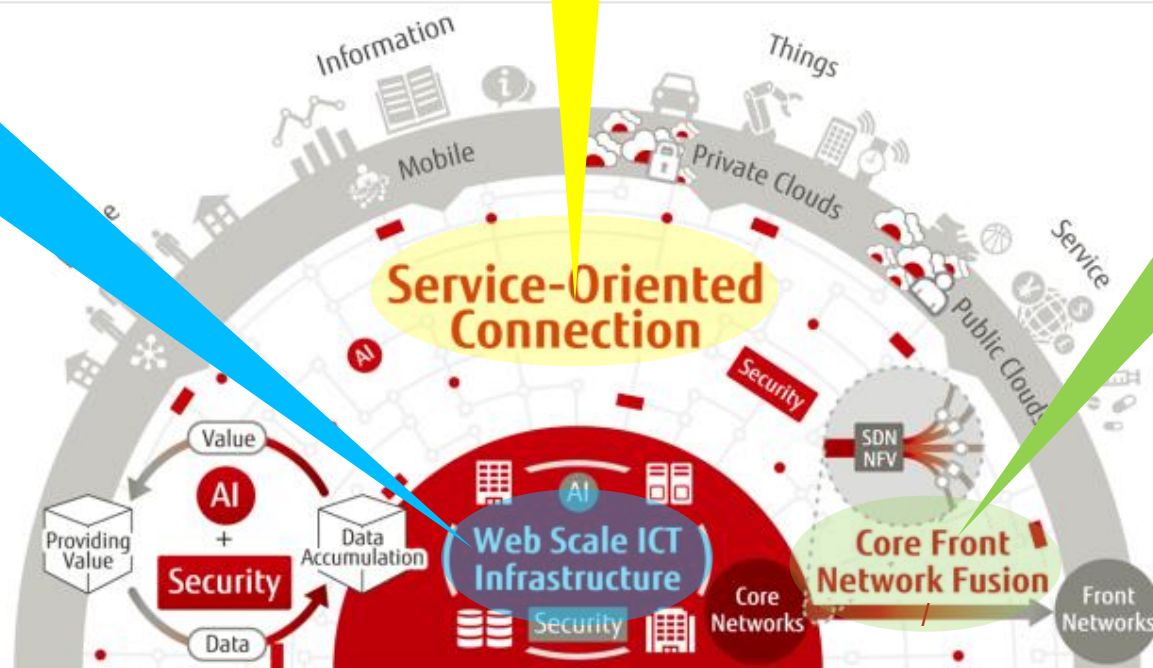
- 3. Cloud Migration Technologies Enabling Digitization of Business System
- 4. Service Co-Creation Platform Promoting the Comfortable Place Development

## Web Scale ICT Infrastructure (2 out of 14) \*

- 5. High-Speed/Large-Scale Deep Learning Based on Supercomputer Technology
- 6. Log-analysis Technologies for Visualizing and Tracking OpenStack's Internal API Calls

## Core/Front Network Fusion (2 out of 13) \*

- 7. Service Networking Technology Enabling Rapid Deployment of IoT Systems
- 8. Compact 300 GHz Receiver for Wireless Communications of Tens of Gigabits per Second



## Leading-Edge Basic Research (4) \*

- 1. Novel Architecture to Rival Quantum Computers

\*Number inside parentheses indicates the number of press releases issued so far since Apr., 2015



# Technology Exhibits presented today (2/2)

## AI (4 out of 18) \*

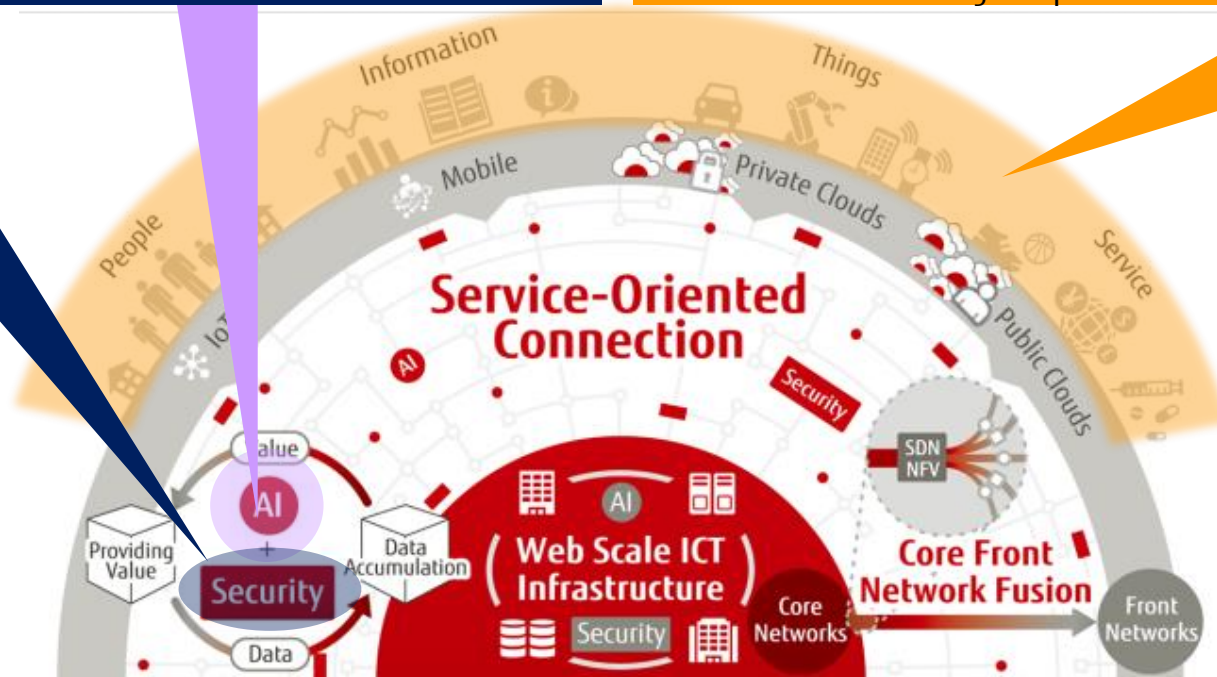
- 2. New Deep Learning Technology Leading to a Discovery from Data Describing All the Connections among People and Things
- 9. Improving Customer Satisfaction through Appropriate Omni-Channel Support
- 10. Automatic Generation of Image Recognition Programs in Production Line Using AI Technologies
- 11. Video Monitoring and Analysis Technology for Intelligent Transportation

## Security (2 out of 7) \*

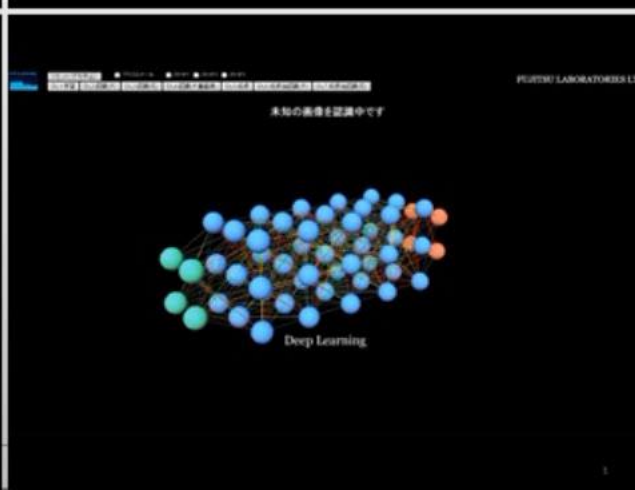
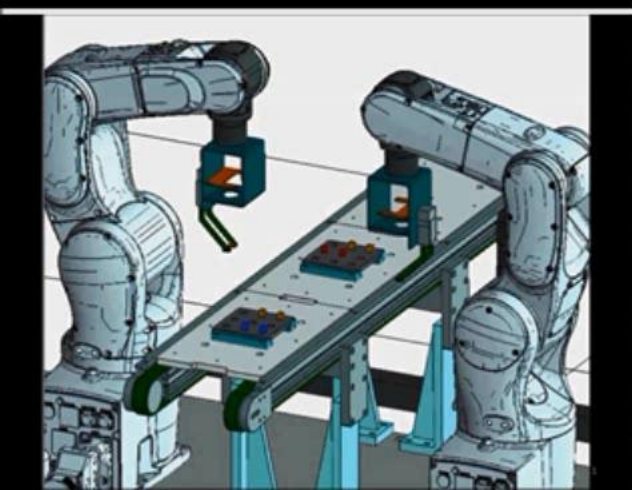
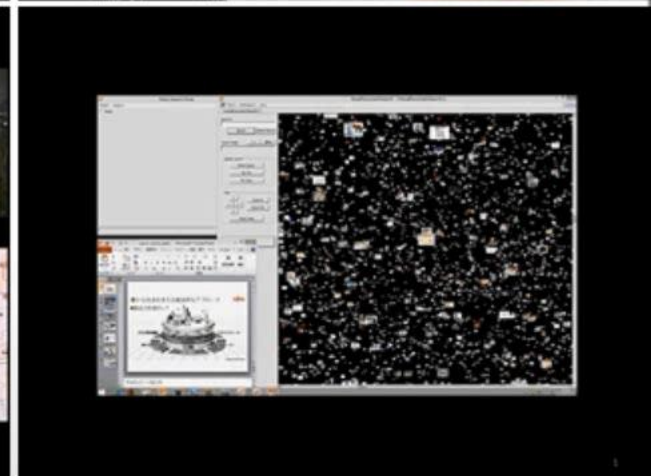
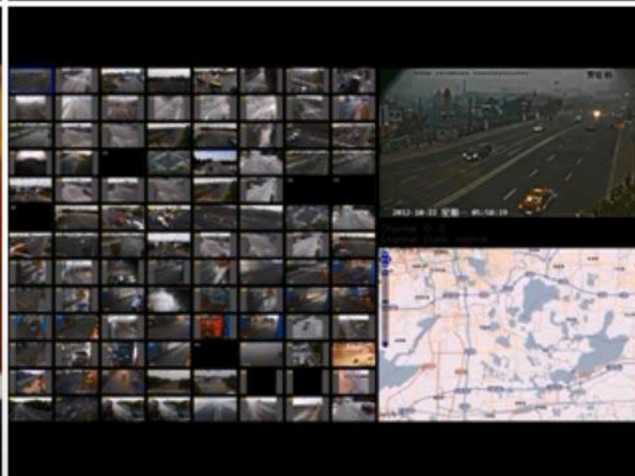
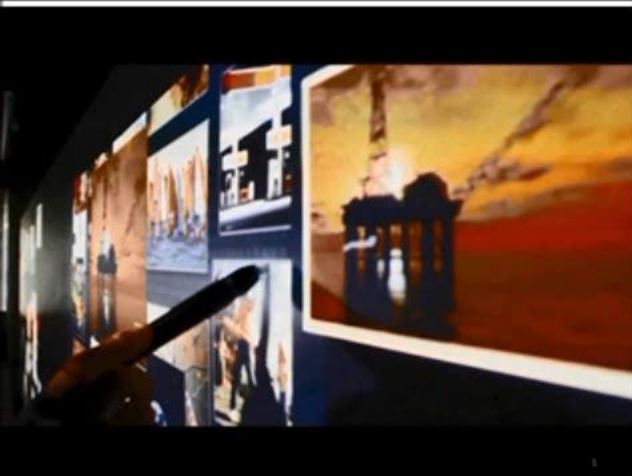
- 12. Biocode Cryptographic Technology for Secure and Simple Use in Cloud Service
- 13. Integrated Cyber Analysis System for Visualizing Whole Picture of Targeted Attacks


## Applied Innovation Research (3 out of 17) \*

- 14. Enhancing Security of Blockchain for Business Use
- 15. Instantly Visualizing the Excellence: Scoring Support for Gymnastics Competitions
- 16. Automatic and Hands-Free Multilingual Speech Translation Technology



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